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(54) Sewage respiration inhibition

(57) An apparatus (10) is provided for introducing CO_2 and O_2 into sewage such that the CO_2 reduces the pH of the sewage to below about 5.0 and reduces the activity of bacteria therein such that the O_2 can oxygenate the sewage rather than be consumed by the bacteria. Generation of malodorous compounds are prevented until the CO_2 disperses and the pH risen above about 5.0.

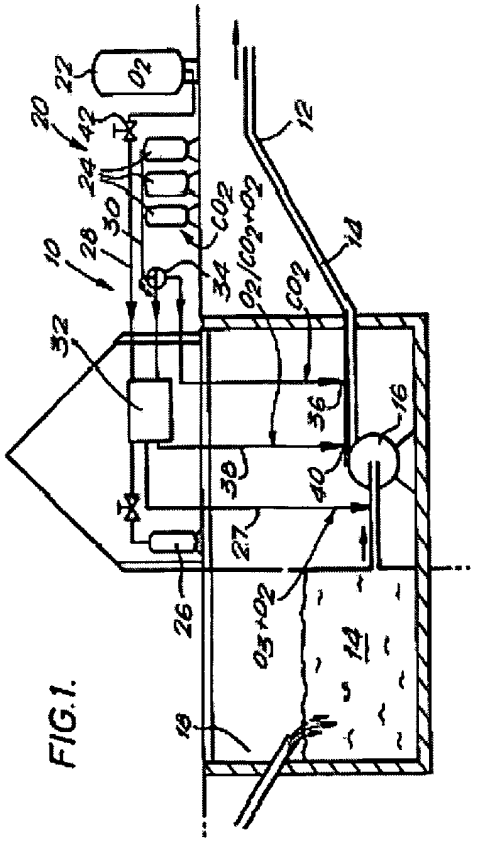

FIG.1.

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Description

The present invention relates to a method of reducing the respiration rate of sewage and relates particularly, but not exclusively, to a method of preventing or reducing the septicity of sewage.

When sewage is being conveyed to a sewage treatment works or when it is undergoing its initial phase of primary settlement, there may be prolonged periods where the sewage is not in direct contact with air and consequently bacteria present will use up the available dissolved oxygen. In the sewerage system these periods can occur when the sewage is at a comparatively high temperature in large gravity sewers where the air surface to volume ratio is low or in pumped sewers or rising mains.

Sewage that has become anaerobic can form malodorous compounds and generate hydrogen sulphide gas which, when liberated from the sewage, can be oxidised by other bacteria to sulphuric acid of sufficient strength to attack concrete and metal fittings. The presence of a large proportion of septic sewage arriving at a sewage treatment works can also have an inhibitory effect on the bacterial reactions in the sewage treatment plant itself.

To prevent septicity of sewage several methods are employed, for example the addition of chlorine or sodium hypochlorite will kill some of the bacteria present and inhibit the respiration rate, similarly iron salts may be added to fix the sulphide ions as black iron sulphide and sometimes oxygen containing compounds such as sodium nitrate are added as an oxygen source for the facultative bacteria present. These methods are not always effective and have the disadvantage of adding chemicals and sometimes heavy metals to the sewage.

One well known method of treatment involves the use of industrial oxygen. This is added to the sewage in such concentration as will balance the demand caused by the bacterial respiration for the period that the sewage is contained under anaerobic conditions. The method is straightforward and environmentally friendly but has a limitation in that under some conditions, high temperatures and/or long retention times, it is impossible to dissolve sufficient oxygen within the liquor. Also if the gas added exceeds the solubility limit of the sewage then undissolved gas can adversely affect pipe pumping capacities etc.

It is an object of the present invention to provide a method of treating sewage which reduces and possibly eliminates the above mentioned problem.

Accordingly, the present invention provides a method of treating sewage having bacteria contained therein, comprising the step of flushing said sewage with a gas containing carbon dioxide and an enhanced amount of oxygen in relation to air.

It will be appreciated that the carbon dioxide has the effect of lowering the pH of the sewage thereby reducing the respiration rate of some of the bacteria. The reduced respiration rate allows the oxygen to oxygenate the sewage rather than being consumed by the bacteria and hence prevents the sewage becoming anaerobic and forming malodorous compounds etc. at critical or sensitive points in the sewage transportation system.

The present invention will now be more particularly described by way of example only with reference to Figure 1 which is a schematic representation of an apparatus for carrying out the present method.

A sewage treatment apparatus shown generally at 10 includes a sewage supply pipe 12 through which sewage 14 is pumped by pump 16 from tank 18. The flushing apparatus 20 comprises a source of oxygen 22 and carbon dioxide 24. Further controlling agents such as, for example ozone, sodium hypochlorite or chlorine may be stored in tank 26 or manufactured on site. Pipes 28, 30 carry oxygen and carbon dioxide to a mixing apparatus 32 the operation of which will be described later herein. An optional valve 34 may be provided for directing carbon dioxide either to the mixing apparatus 32 or directly to an inlet 36 on sewage pipe 12. Oxygen and/or an oxygen/carbon dioxide mixture is added to pipe 12 via outlet pipe 38 and inlet 40. Carbon dioxide is added to the sewage in sufficient quantities to reduce the pH thereof below about 5.0. At such pH levels it has been found that the respiration rate of some of the bacteria present is substantially reduced and, in effect, these bacteria lie semi-dormant until the carbon dioxide disperses and the pH rises above about 5.0. Whilst these bacteria are in a semi-dormant state they consume little if any of the oxygen dissolved in the sewage and therefore the sewage remains aerobic for a longer period thereby temporarily eliminating the formation of anaerobic malodorous compounds including sulphides. In addition, at low pH, ozone is effective in further reducing the bacterial respiration rate. Conveniently, ozone can be generated from pure oxygen and dissolved in the sewage. Often ozone generators work at a lower pressure than that of the pumped sewer and hence it may be necessary to add ozonized oxygen, containing up to 15% ozone, on the suction side of pump 16 or via an eductor or compressor (not shown). Line 27 is provided for this purpose. Any unused ozone will revert to oxygen within a few hours.

In operation, sewage 14 is pumped along pipe 12 and carbon dioxide and oxygen is added to the flow thereof via inlets 36 and/or 40. If it is desired to inject just carbon dioxide then the flow of oxygen is prevented by closing valve 42 whilst allowing CO_2 to be supplied as before. Obviously, in this arrangement the mixer 32 is redundant unless it is desired to add further controlling agents from tank 26. The O_2 and CO_2 may be pre-mixed in mixer 32 and injected co-currently through inlet 40 or may be injected separately, with CO_2 being supplied via inlet 36 downstream of O_2 inlet 40. In this later arrangement, valve 34 is operated so as to direct CO_2 directly to inlet 36 rather than through mixer 32. Dissolution of CO_2 away from the point of oxygenation is attractive be-

cause of the relative ease of dissolving CO_2 compared with O_2. Treated sewage is pumped away for further treatment as the CO_2 slowly disperses and the pH returns to normal. Once the pH rises above about 5.0 the bacterial activity is recommenced however, by this time the sewage may well have passed from the treatment plant and hence malodorous compounds and hydrogen sulphide gas are not formed whilst the sewage is at a sensitive point in the treatment process. Obviously, such an arrangement may be used to treat sewage at any part of its passage through the sewerage system.

It will be appreciated that the present invention makes use of inhibitory agents which are environmentally acceptable and which will not affect bacterial action further into the treatment process. The agents are added to the sewage at the point where the respiration rate needs to be controlled. The quantity added needs to be sufficient to reduce the pH of the sewage to about 5.0 which inhibits bacterial activity particularly that of obligate aerobic and facultative bacteria until such a time as the carbon dioxide disperses and the pH returns to normal.

The carbon dioxide and/or ozone does not necessarily replace the oxygen added but is supplementary to it and may only need to be used at times of extreme conditions, ie, high summer temperatures or low flow-rates.

Carbon dioxide is a natural by-product of respiration by bacteria and in this instance acts as a chemical signal which inhibits bacterial activity. In a normal sewage treatment process a considerable amount of carbon dioxide is liberated but because of the aeration interface this is lost to atmosphere without the pH falling to inhibiting levels.

It is preferable that the sewage does not contain sulphides prior to carbon dioxide as the reduced pH will drive the equilibrium to enhance loss to the atmosphere, although when fully dissolved in a full pipe, or one made of non-corroding material such as GRP the effect may be ignored.

Claims

1. A method of treating sewage having bacteria contained therein, characterised by the step of flushing said sewage with a gas containing carbon dioxide and an enhanced amount of oxygen in relation to air.

2. A method as claimed in Claim 1 characterised in that said carbon dioxide is provided in quantities sufficient to reduce the pH of the sewage to about 5.0 or below.

3. A method as claimed in Claim 1 or Claim 2 characterised in that the carbon dioxide is added downstream of the oxygen.

4. A method as claimed in Claim 1 or Claim 2 characterised in that the carbon dioxide is added co-currently with the oxygen.

5. A method as claimed in Claim 4 characterised in that the carbon dioxide and oxygen are mixed together prior to introduction into said sewage.

6. A method as claimed in any one of the preceding claims characterised by the further step of flushing said sewage with a further controlling agent selected from the group comprising: ozone, chlorine, sodium hypochlorite.

7. A method as claimed in any one of Claims 1 to 6 characterised in that said treatment takes place as said sewage is being conveyed to a sewage treatment works or during an initial phase of primary settlement.

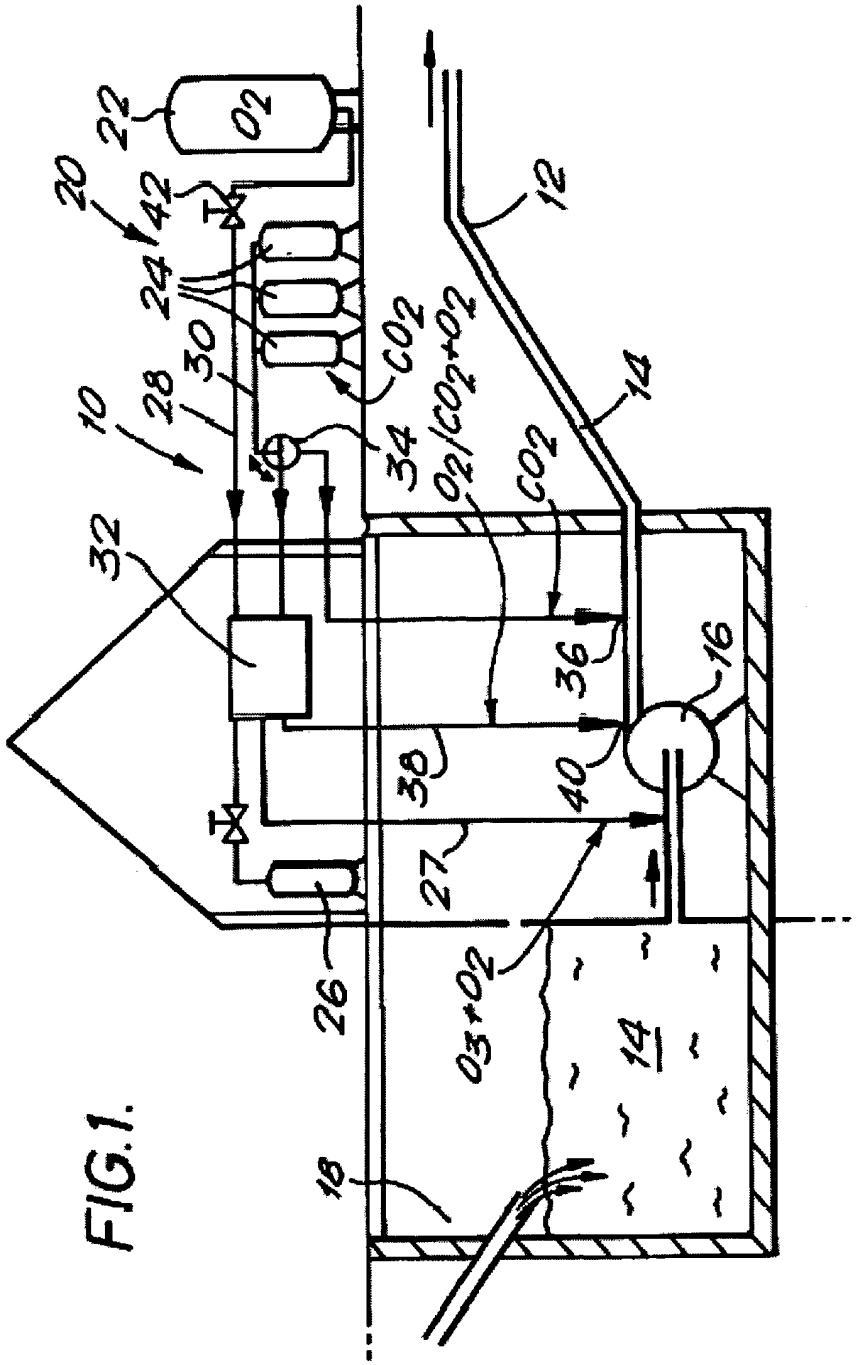
22
O2
20
42
24
30
28
10
CO2
34
O2/CO2+O2
CO2
12
14
32
36
16
38
40
27
26
O3+O2
14
18

FIG.1.

ABSTRACT

The invention relates to a method for operating a sewage system for draining waste water. According to the invention, oxygen is artificially and periodically added to the waste water, for example in that air is periodically blown into a pipe of the sewage system by means of an air pump. The invention furthermore relates to a sewage system for carrying out the present method.